

THE SWEETPOTATO LEAF BEETLE

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INTRODUCTION

In 1931 the writer's attention was called to the damage to sweetpotatoes in certain localities of Currituck County, N. C., caused by the sweetpotato leaf beetle (*Typophorus viridicyaneus*-(Crotch))¹ or "blue beetle", as the insect is known locally.

The studies of the biology of the insect reported herein were conducted at Norfolk, Va., in 1931, 1932, and 1933. The biological studies are supplemented by field observations made in Currituck County, N. C., during the seasons 1931 to 1936, inclusive.

DISTRIBUTION

Crotch,² in an article published in 1873 containing the original description of *Typophorus viridicyaneus*, reported the occurrence of the insect in the United States in the Middle and Southern States and in Illinois. Outside the United States he recorded its occurrence in Mexico. Unfortunately the article by Crotch does not show the date of the first collection of the insect or the specific localities where the collections were made, but the insect must have been found in the United States some time prior to 1873, the date of Crotch's article. Chittenden³ lists the occurrence of the insect on sweetpotato in North Carolina, South Carolina, Arkansas, Mississippi, and Texas.

¹ Order Coleoptera, family Chrysomelidae.

² CROTCH, G. R. MATERIALS FOR THE STUDY OF THE PHYTOPHAGA OF THE UNITED STATES. Acad. Nat. Sci. Phila. Proc. 25: 19-83. 1873. See p. 40.

³ CHITTENDEN, F. H. NOTE ON THE SWEET-POTATO LEAF-BEETLE AND A RELATED MEXICAN FORM. Bull. Brooklyn Ent. Soc. 20: 91-92, illus. 1925.

The insect has also been recorded from Maryland, Virginia, Kentucky, Tennessee, Georgia, and Alabama.

DESCRIPTION

The adult of the sweetpotato leaf beetle was first described by Crotch as *Paria viridicyanea*, sp. n. His original description follows:

Bluish-green (or rarely aeneous); antennae red, club infusate; head foveolate, ocular sulci deep; second joint of antennae distinctly shorter than third; thorax alutaceous, sparingly punctate subquadrate, narrow in front, anterior angles deflexed, sides nearly straight; elytra punctate, striate, smooth. L. .30. Middle and Southern States, Illinois, Mexico.

This species is a little anomalous, but the ocular sulci and thoracic lobes clearly belong here.

The sweetpotato leaf beetle is a hard-shelled insect, oblong-oval, having a metallic bluish-green color. Typical adults measure from 6.0 to 7.5 mm in length and from 4 to 5 mm in width (fig. 1, A).

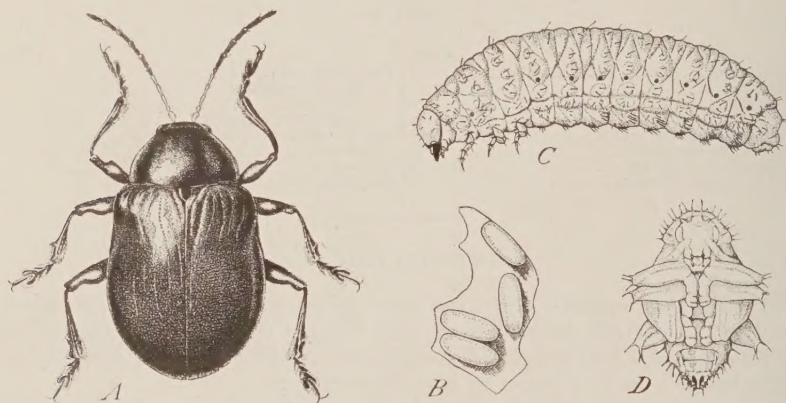


FIGURE 1.—The sweetpotato leaf beetle in its different stages of development: A, Adult, $\times 5$; B, eggs, $\times 6$; C, larva, $\times 4$; D, pupa, ventral view, $\times 3$.

The eggs are small, elongate-oval, ranging from 1.36 to 1.44 mm in length and from 0.56 to 0.64 mm in width. They are lemon yellow and are deposited in clusters of from 3 to 25, glued together in irregular groups (fig. 1, B).

The larva is pale yellow and ranges in length from about 1.5 mm when first hatched to about 11 mm when full grown. The mature larva measures from 3 to 3.5 mm in width (fig. 1, C). It has a distinct brownish head and three pairs of legs, and when in the soil it lies curled up.

The pupa (fig. 1, D) somewhat resembles in shape the mature beetle, except that the legs, antennae, and wings are folded closely to the body. It is pale yellow and about 7 mm long.

FOOD PLANTS

The writer has never observed the sweetpotato leaf beetle attacking any plant other than the sweetpotato (*Ipomoea batatas*). Chittenden,⁴ however, lists wild sweetpotato and morning-glory or tie-vine

⁴ CHITTENDEN, F. H. See footnote 3.

as hosts, and states that for many years before its occurrence on sweetpotato was noted the species was known to attack wild Convolvulaceae. Although morning-glory plants were usually common in infested sweetpotato fields under observation during this investigation, no injury by this beetle was observed on them.

NATURE AND EXTENT OF INJURY

INJURY BY THE ADULTS

The adult of the sweetpotato leaf beetle is less destructive than the larva, but it often causes serious injury to sweetpotato foliage. The beetles feed first on the tender leaves about the crown of the plant

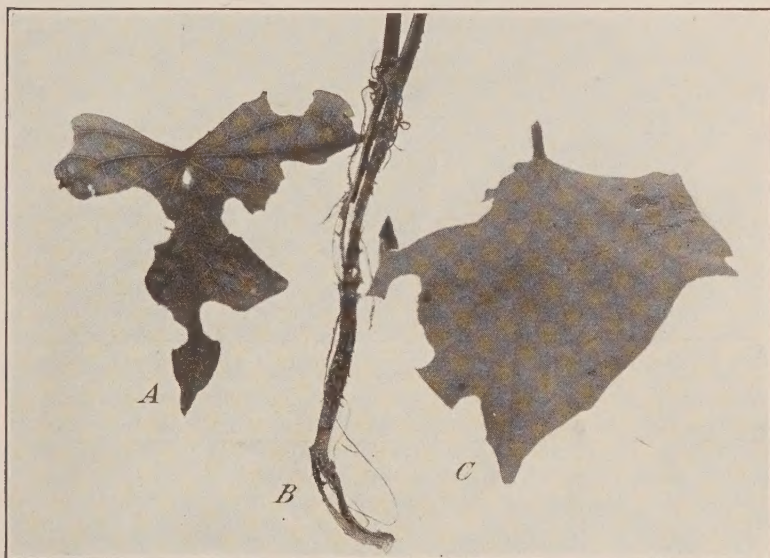


FIGURE 2.—Sweetpotato leaves and stem showing injury caused by the sweetpotato leaf beetle: *A* and *C*, Typical adult injury; *B*, injury to vine caused by young larvae.

and gradually spread over the entire vine. The insect begins to feed at the margin of the leaf and completely devours the leaf inward toward the center (fig. 2, *A* and *C*). The adults have the habit of congregating in large numbers on plants in the part of a field nearest the point where emergence from the soil occurred. Plants thus attacked are often completely defoliated.

INJURY BY THE LARVAE

The larva of the insect is more destructive than the adult, as it damages the vines and roots, whereas the adult attacks only the foliage. The young larva, shortly after it hatches, enters the sweetpotato vine below the surface of the ground and often causes severe injury to this part of the plant (fig. 2, *B*). After the roots have formed, the larvae bore into them, giving them a very unsightly

appearance on the outer surface (fig. 3), and causing severe damage to the inside of the root (fig. 4). Roots thus injured are unmarketable.

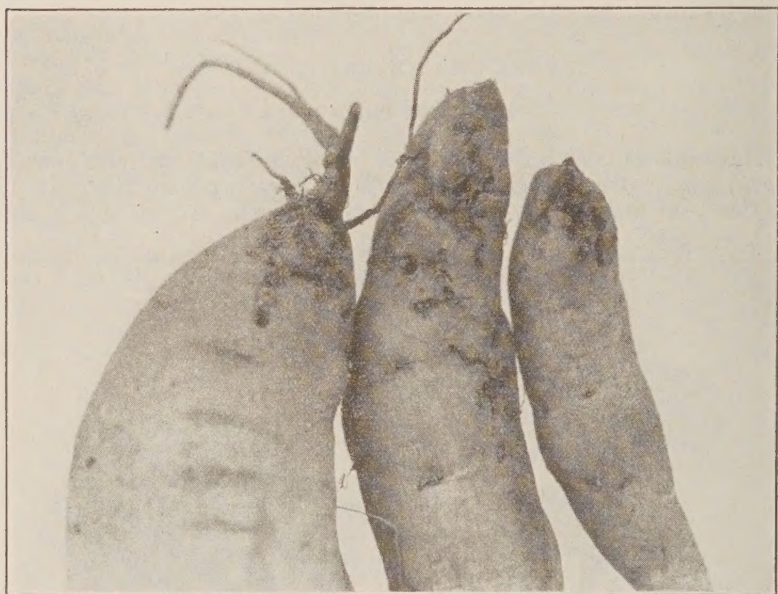


FIGURE 3.—Sweetpotatoes injured on the outer surface by larvae of the sweetpotato leaf beetle.



FIGURE 4.—Cross section of sweetpotato showing the injury done by larvae of the sweetpotato leaf beetle.

POSSIBLE MEANS OF SPREAD

The writer has found live larvae in potatoes 90 days after harvest, from which it appears that the sweetpotato leaf beetle may be carried by the shipment of infested potatoes, and that larvae of the insect may be present in potatoes placed in storage in houses, cellars, or dirt banks. K. L. Cockerham,⁵ reporting on observations made in Mobile County, Ala., on December 9 and 10, 1936, relative to this insect, also found live larvae in stored potatoes several months after harvest. He said:

Approximately 5 bushels of potatoes were destroyed on one farm. On another farm approximately 3 percent of the potatoes remaining in storage had been damaged by *Typophorus* larvae. This grower reported that the part of the crop already consumed had suffered even greater damage. * * * On one farm where the potatoes had been banked in the ordinary manner, the base of the bank was dug up and it was found that the larvae had burrowed into the soil, where they were apparently passing the winter in the larval stage. A few specimens were also found still remaining in the potatoes.

The observations by Cockerham confirm those of the writer, and further show that the insect may be transported by the shipment of potatoes removed from storage several months after harvest as well as by newly dug potatoes. However, since the insect has not caused any particular damage outside of a few restricted localities in the Southern States, it is apparent that it does not readily establish itself if introduced by the movement of infested potatoes.

LIFE HISTORY AND HABITS

REARING METHODS

Although Chittenden gave some general observations on the occurrence and reported damage caused by the insect in certain localities and compared it with a related Mexican form, *Typophorus sturmi* Lefevre, little has been known concerning its biology. It was therefore necessary at the outset of the investigation to devise rearing methods whereby the various phases of the life history could be kept under observation.

Mating pairs of the insect were confined in glass jars 5 inches high and 4 inches in diameter, the tops of which were covered with cheesecloth. Approximately 1½ inches of sand was placed in the jars and potato draws were pressed into the sand for food for the beetles. The sand was moistened as often as required to keep the potato draws fresh. Each day both the foliage of the potato draws and the sand in the jars were examined for eggs. Any eggs found were counted and kept under daily observation so that data relative to the incubation period could be obtained. When eggs were found in a jar the male and female were transferred to another jar.

Larvae and pupae were reared in the jars in which the eggs were laid. Immediately after the eggs in any jar hatched a fresh sweetpotato draw was stuck in the sand and a small root was buried beneath the surface in order that the young larvae might have their choice of food. It was thus possible to study the feeding habits of the larvae.

⁵ Unpublished notes.

Late in the fall the larvae in the various jars were counted and placed in the bottoms of the jars in order to facilitate observation during the winter. They were then covered with sand, which was moistened at intervals. It was thus possible to make observations on winter activity of the larvae and to obtain data respecting survival. Early in the spring counts of live larvae were made in completing the records on winter survival. The larvae were then placed in artificial cells along the outer edges of the bottoms of the jars and covered with about $1\frac{1}{2}$ inches of moist sand. By handling the larvae in this manner it was possible to observe the date of pupation, date of emergence of adults in the soil, changes in coloration after emergence in the soil, and the period between emergence in the soil and appearance on the soil surface.

THE ADULT

EMERGENCE

Pupation occurs in simple earthen cells several inches below the soil surface. After transformation from the pupal stage the newly formed beetle is light brown and very soft. Within 24 hours the color changes to dark brown. In another 24 hours it changes to bluish green, which is the natural color of the adult. For several days before making their way to the surface, the newly formed adults remained in the cell where transformation occurred. The average length of time in 1932 was 4.2 days and in 1933, 5.1 days. After appearance on the soil surface the beetles waited for about 2 days before commencing to feed, the average length of time having been 2.3 days in 1932 and 1.9 days in 1933.

OVIPOSITION

The mated female feeds for about 2 weeks after emergence before depositing eggs. In 1932 the preoviposition period ranged from 10 to 22 days, the average being 14.1 days.

In the insectary about half the eggs were deposited just beneath the surface of the soil near the base of the plant and half in the folds of newly formed leaves on the plant. Observations made in the field indicate that the eggs are normally deposited in the soil.

The eggs are placed in clusters of from 3 to 25, the average observed being 12. They are laid flat on their sides, glued together in irregular groups, frequently being piled one on top of another. As many as 78 eggs have been deposited by a single female, the average number being 50.

From records obtained in 1931 and 1932 the oviposition period ranged from 12 to 53 days, the average being 29.

RATE OF DEVELOPMENT

Table 1 shows the developmental periods of 10 individuals of *Typophorus viridicyaneus* reared during 1932 and 1933. It will be seen that the incubation period ranged from 6 to 10 days, the larval period from 263 to 319 days, and the pupal period from 16 to 21 days. Pupation began on May 16 and continued to May 17.

The length of the developmental period from egg to adult ranged from 291 to 346 days. Adult emergence was completed during the period from May 29 to June 4. Apparently no definite relation exists between mean temperature and length of the developmental period.

The average length of life of the adult in the insectary was 41.3 days in 1931 and 32.8 days in 1932. The maximum length of life recorded for the two seasons was 88 days.

TABLE 1.—*Developmental period of the sweetpotato leaf beetle (10 individuals) at Norfolk, Va., 1932-33*

Date egg deposited	Date egg hatched	Incubation period	Date pupated	Larval period	Date of emergence	Pupal period	Developmental period	Mean temperature
1932	1932	Days	1933	Days	1933	Days	Days	° F.
June 23-----	July 2-----	9	May 17-----	319	June 4-----	18	346	62.6
Do-----	do-----	9	May 12-----	314	May 31-----	19	342	62.1
Do-----	July 3-----	10	May 13-----	314	do-----	18	342	62.1
June 24-----	July 2-----	8	May 17-----	319	June 4-----	18	345	62.6
Do-----	July 3-----	9	May 10-----	311	May 29-----	19	339	61.8
June 25-----	July 2-----	7	May 15-----	317	May 31-----	16	340	62.1
June 28-----	July 4-----	6	May 16-----	316	June 3-----	18	340	62.4
July 2-----	July 12-----	10	May 10-----	302	May 31-----	21	333	60.5
July 8-----	July 18-----	10	May 15-----	301	June 2-----	18	329	60.5
Aug. 15-----	Aug. 25-----	10	do-----	263	do-----	18	291	59.1
Average-----		8.8		307.6		18.3	334.7	

SEASONAL HISTORY

In the latitude of eastern North Carolina, the first sweetpotato leaf beetles leave the ground during the last part of May, and adults may be found from then until about the middle of July. The eggs hatch in about 9 days and may be found from the last of June till the first part of August.

Newly hatched larvae enter the sweetpotato vine usually at the root end and begin feeding in the vine. After the enlarged roots have formed the larvae bore in them and there they feed and grow. Records of larvae in confinement in cages in the insectary indicate that the majority are full-grown and have left the potato and entered the soil by the time the roots are dug (usually during August in Currituck County), although a number are still present in the roots at this time. It is indicated from cage records and field observations that young larvae present in vines and small potatoes after the crop is harvested continue to feed and develop until frost. In view of the fact that young larvae have never been found in the soil in the spring, it is apparent that the immature larvae are unable to survive the winter in this locality.

About the middle of October the full-grown larvae move downward in the soil to depths ranging from 6 to 8 inches, where they become inactive and pass the winter in this dormant condition.

The greater part of the life of the sweetpotato leaf beetle is spent in the larval stage, which continues from the time the eggs hatch in July and the first part of August through the fall and winter and until the middle of the following May. The larva then sheds its skin and becomes a pupa. Pupae are present in the soil normally from

the middle of May to the first part of June, the time spent in this stage averaging 18 days. At the end of this period the pupal skin splits and the newly formed beetle appears, but it remains within the pupal cell for about 4 days longer until its body has become hardened and its color has changed from light brown to bluish green. It then burrows upward and emerges from the soil as the fully formed beetle.

These studies show that almost a year is required for development of one generation of the insect. This, together with the fact that the total number of eggs deposited by a single female is relatively small, no doubt partially explains the lack of economic importance of the insect in the Southern States.

HIBERNATION

On November 12, 1932, 46 larvae were placed in a hibernation cage in the field in order to obtain data on winter survival. Thirteen adults, 28.3 percent, emerged between June 8 and 12, 1933.

On the same date that these larvae were placed in hibernation, 104 larvae reared in the life-history experiments were placed in artificial hibernation in rearing jars in the insectary. The soil in these jars was moistened as required during the winter. It was found on May 9, 1933, that 35 larvae, or 33.65 percent, had survived the winter. Adult emergence from the jars was completed within a 6-day period, the data closely paralleling those of natural hibernation.

CONTROL

No general field infestation of this insect has been observed since the investigations were undertaken, the majority of the injury noted being confined to scattered spots along the borders of fields.

In the life-history studies it was shown that the adults emerge from the soil within a period of about a week late in May and early in June and that the average period between emergence and oviposition is 14 days. From this it is apparent that there is a period of about 15 to 20 days in which insecticides may be applied before eggs are deposited in the soil.

In 1932, plots were arranged to test the effectiveness in the field of several materials for the control of this insect, but the field infestation was so light that this phase of the experiment was abandoned. No insecticidal injury was observed, however, on sweetpotatoes following two field applications of any of the following materials: Calcium arsenate, undiluted; calcium arsenate, 1 part, with hydrated lime, 7 parts, by weight; magnesium arsenate, 1 part, with hydrated lime, 3 parts; cryolite, 1 part, with infusorial earth, 2 parts; and 80-percent barium fluosilicate, 1 part, with infusorial earth, 2 parts.

The results of toxicity tests in cages indicate that undiluted calcium arsenate, 80-percent barium fluosilicate 1 part with infusorial earth 2 parts by weight, and synthetic cryolite 3 parts with talc 2 parts are highly toxic to the adult sweetpotato leaf beetle. These materials were more toxic than derris or cube dusts containing 0.50 percent of rotenone, or a water suspension of ground derris root at a dosage equivalent to 2 pounds of derris of 4-percent rotenone content in 50 gallons of water (rotenone content of spray 0.02 percent).

In one instance a grower applied undiluted calcium arsenate dust in an effort to control the insects in a small part of a field. Several days after the treatment the writer found 40 to 50 dead beetles on the ground beneath the treated plants, but no live beetles were observed on the plants.

Since the beetles congregate in large numbers on plants near the places where they emerged from the soil, they may be easily picked off by hand and destroyed, if this is done before they disperse.

SUMMARY

The sweetpotato leaf beetle, an insect enemy of sweetpotatoes first recorded in the United States in 1873, has caused some damage periodically in certain localities in the Southern States.

The larvae, or grubs, may be carried by the shipment of worm-infested sweetpotatoes and may also be found in the stored potatoes. Judging from the history of the insect in the United States it does not appear that the transportation of the grubs in the vines and potatoes presents any danger to uninfested areas.

Beetles begin to emerge during the last part of May and may be found until about the middle of July. They feed on sweetpotato foliage. The female lays about 50 eggs during the summer. These eggs hatch in approximately 9 days, and the larvae feed in the vines and roots of the plants. The majority of the larvae are full grown and have left the root and entered the soil by the time the crop is harvested, although a number are still present in the roots at this time. The insect passes the winter in the larval stage in the soil at depths of 6 to 8 inches. Pupation begins during the first part of May, and after spending about 18 days as pupae the insects transform into beetles. The entire life cycle requires almost a year.

In view of the fact that the adults emerge from the soil within a period of about a week late in May and early in June, and since the average period between emergence and oviposition is about 14 days, there is a period of about 15 to 20 days in which insecticides may be applied before eggs are deposited in the soil.

The results of toxicity tests in cages indicate that undiluted calcium arsenate, 80-percent barium fluosilicate-infusorial earth (1 part to 2 parts by weight), and synthetic cryolite (3 parts to 2 parts of talc) are highly toxic to the adult.

As the beetles congregate in large numbers on plants near the places where they have emerged, the newly emerged adults may be easily picked off by hand and destroyed.

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